PATENT SPECIFICATION

Application Date Oct. 25, 1930. No. 32,118 / 30.

363,764

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PROVISIONAL SPECIFICATION.

Improvements in or relating to Power Units Employing Internal Combustion Engines for Rail Locomotives.

I, ALAN ERNEST LEOFRIC CHORLTON, C.B.E., British Subject, of 55, Lower Belgrave Street, Eaton Square, London, S.W. 1, do hereby declare the nature of this invention to be as follows:—

This invention relates to power units employing internal combustion engines for rail locomotives, and has for its object to provide an improved power unit which will be of a compact and efficient construction and will be applicable to locomotives the structure of other parts of which follows to some extent existing practice.

To this end an internal combustion engine power unit for rail locomotives according to the present invention comprises an internal combustion engine preferably of the liquid fuel injection compression ignition type having a two-throw crankshaft disposed transversely with respect to the length of the locomotive. with means for transmitting power to the locomotive track wheels through a variable speed mechanism from a point in the length of the crankshaft between the two crank throws, and two groups of radially arranged cylinders disposed so that each crank throw is acted upon by the pistons in the cylinders in one group, each group comprising a plurality of cylinders which lie adjacent and all on one side of a plane containing the crankshaft axis. Conveniently the crankshaft is formed in two parts each including one of the crank throws, the adjacent ends of these two parts being provided with flanges and bolted together and to a gear wheel or like transmission member whereby power is transmitted from the crankshaft through the variable speed transmission mechanism to the locomotive track wheels. In combination with the above construction means are preferably provided for moving the crankshaft bodily towards and away from the cylinders so as to vary the effective compression ratio, while the cylinders in each group are conveniently angularly displaced from one another by as small an angle as is practicable and are provided with supercharging ports so disposed in their walls that when the crankshaft is moved towards the cylinders these ports will not be uncovered by the pistons at the ends of their suction strokes whereas when the crankshaft is moved away from the cylinders the supercharging ports will be uncovered at the end of each piston suction stroke to admit a supercharge, the mechanism for transmitting power from the crankshaft to the track wheels being so constructed and arranged as to permit the necessary bodily movement of the crankshaft. The arrangement is preferably such that the reduction in the effective compression ratio of the engine and the admission of the supercharge when the crankshaft is moved away from the cylinders causes the maximum compression pressure in each cylinder to be substantially the same as when the effective compression ratio is reduced and the admission of the supercharge cut off by moving the crankshaft towards the cylinders. Further the mechanism for moving the crankshaft towards and away from the cylinders is preferably interconnected with mechanism controlling the fuel pump or pumps so as to enable the quantity of fuel injected to be increased when supercharging to an extent corresponding to the additional air admitted.

In this way it is possible to provide a power unit in which the power output can be increased above the normal maximum load to meet overload conditions without the necessity for making the parts of the engine stronger or heavier than is required for working under normal conditions since the maximum pressures involved are substantially the same both for normal maximum load and for overload conditions. The movement of the crankshaft towards and away from the cylinders may be effected in various ways but in a convenient arrangement the crankshaft bearings are eccentrically mounted in rotatable members so that by rotating these members the crankshaft can be moved towards or away from the cylinders.

The number of cylinders in the group associated with each crank throw may vary but conveniently each group comprises three cylinders. Further, these

cylinders are preferably arranged so that the axis of the centre cylinder is substantially vertical, although in same cases it may be desirable to arrange the cylinders so that the axis of the centre cylinder is inclined or horizontal.

Various forms of variable speed transmission mechanism may be employed but preferably a combined epicyclic and hydraulic variable speed gear of the kind described in the specification of the present applicant's British Patent Application (Serial No. 359,552) No. 22,434 of 1930 is used. Such a variable speed transmission mechanism combines epicyclic and hydraulic elements and comprises driving, driven and intermediate elements constituted, one by a sun wheel, another by a spider carrying planet wheels which mesh with the sun wheel, and the third element by an internally toothed annulus also meshing with the sun wheel. One or more of the planet wheels cooperate with the sun wheel or annulus to form a gear wheel pump tending to deliver fluid from an inlet passage through an outlet passage, and a control valve is provided for controlling the flow of fluid through the outlet passage so that the pump constitutes a hydraulic clutch for progressively coupling together the three elements of the gear when a direct drive is to be transmitted therethrough, while by permitting free flow of fluid through the pump and braking one of the intermediate elements of the gear either by means of a detent or otherwise, an indirect drive can be effected.

With this arrangement it will be seen that, if the sun wheel and the spider respectively constitute the driving and driven members and the annulus is held stationary, say by a detent, while free flow of fluid is permitted through the pump or pumps by the control valve, an indirect drive will be transmitted through the gear as in an ordinary epicyclic gear. If now the flow of fluid through the pump or pumps is progressively reduced by the control valve, the sun wheel will gradually be coupled to the spider and annulus until the annulus, which has, during the indirect drive, been held from rotation in the opposite direction to the sun wheel and the spider, begins to be carried forward with the sun wheel and the spider. At this point the annulus is freed by its detent, preferably automatically, whereupon further closing of the control valve continues the progressive coupling of the sun wheel, the spider and the annulus until, when the control valve is completely closed, a virtually direct drive is transmitted from the sun wheel to the spider and these two members and the annulus rotate as a unit. Similarly, if the gear ratio is to be reduced, the control valve is progressively opened until a point is reached at which the annulus is stationary. The detent or the like then comes into operation to prevent backward movement of the annulus and further progressive opening of the control valve then brings smoothly into operation an indirect drive through the epicyclic gear. Thus the change from the indirect to the direct drive and vice versa can be effected gradually without shock and without any interruption in the continuous transmission of power so that the transmission mechanism is particularly suitable for use on locomotives.

Two or more combined epicyclic and hydraulic variable speed gears as above described may be arranged in series, and after engagement of a main clutch the control valves may be closed progressively one after the other so as to provide a series of gear ratios through which the drive is continuously transmitted from the lowest ratio to the highest or direct drive in a smooth and progressive manner without any interruption in the continuity of the drive.

In an alternative arrangement the rotation of the annulus in a direction opposite to that of the driving and driven members may be controlled by a slipping clutch preferably of the hydraulic type, and in this case no separate main clutch need be provided since when the clutch controlling the annulus is disengaged and the control valve of the gear is open, no drive will be transmitted, while by progressively braking the annulus the indirect drive can be brought smoothly into operation and after such indirect drive is established the control valve can be progressively closed so as to bring into operation the direct drive, the clutch controlling the annulus being released at the point in the closing of the control valve at which the annulus begins to tend to rotate in the same direction as the sun wheel and spider. Thus, in a convenient arrangement the hydraulic or other clutch controlling the annulus has the member to which the torque on the annulus is transmitted through the clutch rotatably mounted and provided with a detent or like unidirectional braking device which prevents rotation thereof in the opposite direction to that of the sun wheel and spider but permits free rotation thereof in the same direction as the sun wheel and spider. In this way the clutch can only be used to prevent reverse rotation of the annulus and always permits free rotation of the annulus in the same direction as the sun wheel and spider when

this tends to take place.

The invention may be carried in practice in various ways but the following is a description by way of example of one construction of power unit for locomotives according to this invention.

The power unit comprises a frame comprising two longitudinal girders spaced apart. Supported by this frame is an internal combustion engine of the liquid fuel injection compression ignition type comprising a two-throw crankshaft disposed transversely of the frame and formed in two parts each carrying one throw, the adjacent ends of these parts being provided with flanges and bolted together and to a gear wheel. Associated with each crank throw are three radially arranged cylinders, the angle between the cylinders conveniently being as small as is practicable and the centre cylinder preferably having a vertical axis. The crankshaft is supported in bearings eccentrically arranged within rotatable members, the angular position of which can be so varied as to move the crankshaft as a whole towards or away from the cylinders. Formed in the wall of each cylinder is a supercharging port so disposed that when the crankshaft is moved as a whole towards the cylinders, the pistons will not uncover the supercharging ports at the ends of their suction strokes but when the crankshaft is moved away from the cylinders, the supercharging ports will be uncovered by the pistons to admit a supercharge at the end of each suction stroke. The quantity of supercharge admitted is so determined in relation to the reduction in the effective compression ratio effected by the movement of the crankshaft away from the cylinders, that the maximum compression pressure in each cylinder when supercharging is taking place is approximately the same as the maximum compression pressure when the crankshaft is moved towards the cylinders so as to increase the effective compression ratio and maintain the supercharging ports continually closed. Thus the engine structure can be made only of sufficient strength to withstand the normal working pressures without supercharging and yet can operate with supercharging at increased output during overload conditions without increasing the stresses in the various parts of the engine.

The mechanism for moving the crankshaft towards and away from the cylinders may be coupled to mechanism controlling the fuel injection apparatus so as to enable a larger quantity of fuel to be injected when the supercharge is admitted than when the engine is operating under normal conditions without supercharging.

The supercharging charge may be delivered in various ways, for example from a blower driven by the crankshaft or from the crank case.

Mounted in the frame with its axis parallel to the crankshaft axis is a jack shaft which is coupled to the track wheels by connecting rods in known manner and carried by or connected to this jack shaft is variable speed transmission mechanism having a driving gear wheel which meshes with the gear wheel mounted on the crankshaft at a point between the two crank throws. The form of the transmission mechanism may vary but preferably is of the kind described in the specification of the present applicant's British Patent Application No. 22,434 of 1930 referred to above.

If desired instead of the variable speed transmission mechanism being carried by the jack shaft, it may be separately supported and may be connected to the jack shaft by suitable transmission mechanism. Further, instead of the drive being transmitted from the internal combustion engine to a jack shaft, it may be transmitted through other types of transmission apparatus to an axle or to the track wheels of the locomotive.

It is to be understood that the constructions more particularly described above are given by way of example only and that the number of cylinders in each cylinder group, the direction in which the axes of these cylinders projects, the form of mechanism for transmitting power from an intermediate point in the two-throw crankshaft to the track wheels of the locomotive, and other details of construction may be varied without departing from this invention.

It will be seen that a power unit according to the present invention is of a compact form, is suitable for use on a locomotive, and can be conveniently employed for driving a jack shaft, so that the other parts of the locomotive transmission mechanism can follow substantially existing practice.

Dated this 25th day of October, 1930.

KILBURN & STRODE,
Agents for the Applicant.

COMPLETE SPECIFICATION.

Improvements in or relating to Power Units Employing Internal Combustion Engines for Rail Locomotives.

I, ALAN ERNEST LEOFRIC CHORLTON, C.B.E., British Subject, of 55, Lower Belgrave Street, Eaton Square, London, S.W. 1, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to power units of the kind employing an internal combustion engine of the kind having a two-throw crankshaft with means for transmitting power from a point in the length of the crankshaft between the two cranks, and has for its object to provide an improved power unit which will be of a compact and efficient construction, such power unit when applied to locomotives enabling the structure of other parts of the locomotive to follow to some extent existing practice.

To this end an internal combustion engine power unit according to the present invention comprises an internal combustion engine preferably of the liquid fuel injection compression ignition type having a two-throw crankshaft with means for transmitting power from a point in the length of the crankshaft between the two cranks, and two groups of radially arranged cylinders disposed so that each crank throw is acted upon by the pistons in the cylinders in one group, each group comprising a plurality of cylinders which lie adjacent and all on one side of a plane containing the crankshaft axis. In combination with the above construction means are preferably provided for moving the crankshaft bodily towards and away from the cylinders so as to vary the effective compression ratio in a manner known per se, while the cylinders in each group are conveniently angularly displaced from one another by as small as angle as is practicable and are provided with supercharging ports so disposed in their walls that when the crankshaft is moved towards the cylinders these ports will not be uncovered by the pistons at the ends of their suction strokes, whereas when the crankshaft is moved away from the cylinders the supercharging ports will be uncovered at the end of each piston suction stroke to admit a supercharge, the mechanism for transmitting power from the crankshaft to the track wheels being so constructed and arranged as to permit the necessary bodily movement of the crankshaft. The arrangement is further preferably such that the reduction in the effective compression ratio of the engine and the admission of the supercharge when the crankshaft is moved away from the cylinders causes the maximum pressure in each cylinder to be substantially the same as when the effective compression ratio is increased and the admission of the supercharge cut off by moving the crankshaft towards the cylinders. Further, the mechanism for moving the crankshaft towards and away from the cylinders is preferably interconnected with mechanism controlling the fuel pump or pumps so as to enable the quantity of fuel injected to be increased when supercharging to an extent corresponding to the additional air admitted.

In this way it is possible to provide a power unit in which the power output can be increased above the normal maximum load to meet overload conditions without the necessity for making the parts of the engine stronger or heavier than is required for working under normal conditions since the maximum pressures involved are substantially the same both for normal maximum load and for overload conditions. The movement of the crankshaft towards and away from the cylinders may be effected in various ways but in a convenient arrangement the crankshaft bearings are eccentrically mounted in rotatable members so that by rotating these members the crankshaft can be moved towards or away from the cylinders.

The number of cylinders in the group associated with each crank throw may vary but conveniently each group comprises three cylinders. Further, these cylinders are preferably arranged so that the axis of the centre cylinder is substantially vertical, although in some cases it may be desirable to arrange the cylinders so that the axis of the centre cylinder is inclined or horizontal.

In any case each crank throw may be supported solely in bearings lying on the side thereof adjacent to the other crank throw. With such an arrangement roller bearings both for the crankshaft and between the crank pin and connecting rod or

rods coupled thereto can readily be employed.

Various forms of variable speed transmission mechanism may be employed for transmitting power from the crankshaft for example to the track wheels of a locomotive, but preferably a variable speed transmission gear of the kind forming the subject of the present applicant's copending British Patent Application (Serial No. 359,552) No. 22,434 of 1930 is used comprising gear wheels in constant mesh and constituting gearing capable of transmission at a plurality of fixed gear ratios which are independent of torque variations, a hydraulic clutch or brake mechanism which is operative to cause transmission at one fixed ratio, a second hydraulic clutch or brake mechanism operative to cause transmission at a second fixed ratio, and means, for example a free-wheel device, whereby the first clutch or brake mechanism can prevent relative rotation between two parts so as to cause transmission at said first fixed ratio but permits such relative rotation as is necessary when operating at the second fixed ratio so that by progressively bringing into operation the second clutch or brake mechanism a change can be made from the first to the second fixed ratio without controlling the first clutch mechanism, such clutch mechanism remaining operative to maintain transmission of torque until the moment when the torque transmission has been taken over by the operation of the second clutch or brake mechanism.

In this way it will be seen that the transmission of power can be maintained without interruption not only during the operation of the necessary clutch to start the transmission of power but also during the periods of transition from one fixed gear ratio to another whereby an uninterrupted drive is obtained both when starting from rest and passing through the various gear ratios to the highest gear ratio and also when changing from any gear ratio to a lower or higher gear ratio during running.

The invention may be carried into practice in various ways but one construction according to this invention and two modifications of such construction are illustrated somewhat diagrammatically by way of example in the accompanying drawings, in which

Figure 1 is a sectional side elevation of one form of power unit according to this invention.

Figure 2 is a front elevation, partly in section, of the arrangement shown in Figure 1.

Figure 3 is a similar view to Figure 1 of a modified construction of internal combustion engine which may be used in a power unit according to this invention, and Figure 4 is a diagrammatic plan view of a further modification according to this invention.

In the construction illustrated in Figures 1 and 2, the power unit is supported from the longitudinal frame members A of the locomotive by transverse girders B, and comprises two internal combustion engines of the liquid fuel injection compression ignition type, each having a crank case or frame C on which are mounted three cylinders D, D^1, D^2, the axes of which lie at an angle to one another as shown in Figure 2. Each cylinder has an inlet valve E, an exhaust valve F and a fuel injection valve G, and is provided in addition with a supercharging port D^3 in its wall.

Rotatably mounted in housings C^1 in the crank case or frame C of each engine are two bosses H eccentrically mounted within which are bearings H^1 for the crankshafts H^2 which are coupled by connecting rods H^3 to pistons J in the cylinders D, D^1, D^2. Mounted on or formed integral with the bosses H at points outside the crank case or frame C are gear wheels H^4 which mesh with gear wheels K on a shaft K^1 supported in bearings K^2 below the crank case C. Mounted on one end of the shaft K^1 is a worm wheel K^3 engaged by a worm K^4 on a shaft K^5 having a hand wheel K^6. It will be seen that by rotating the hand wheel K^6 the shaft K^5 can be caused to act through the worm K^4 and worm wheel K^3 to rotate the shaft K^1. The gear wheels K will then act through the gear wheels H^4 to rotate all the bosses H simultaneously, such movement, by reason of the eccentricity of the crankshaft bearings H^1 in the bosses H, serving to move the crankshafts H^2 bodily towards or away from the cylinders. This movement is such that with the bosses in the position shown in Figure 1 the pistons J will not, at the end of their suction strokes, uncover the supercharging ports D^3, but when the bosses are rotated so as to move the crankshafts bodily away from the cylinders, the pistons will, at the end of their suction strokes, uncover the supercharging ports D^3 to admit a supercharge. Thus, the engine can either operate with a higher compression ratio and no supercharge, or a lower compression ratio and a supercharge, the quantity of the supercharge admitted preferably being such in relation to the variation in the effective compression ratio of the engine due to bodily movement of the crankshaft that whether the engine is operating with the

higher compression ratio and no supercharge or with the lower compression ratio and a supercharge, the maximum pressures in the cylinders will be substantially the same.

Mounted between and connected to the two crankshafts is a gear wheel L which meshes with a gear wheel L^1 forming the driving member of a variable speed gear L^2 the driven member of which is constituted by a transverse shaft L^3 supported in bearings in the locomotive frame A and carrying at its ends cranks L^4 which are adapted to be coupled by connecting rods to the track wheels of the vehicle for the purpose of transmitting power thereto.

Figure 3 shows an alternative form of engine which may be adopted instead of that shown in Figures 1 and 2 in a power unit according to the present invention, this engine being designed so as to enable roller bearings to be used both for the crankshaft and between the crank pins and the connecting rods.

To this end the power unit shown in Figure 3 comprises two engines each having a crank case or frame M supporting three cylinders N within which are mounted pistons (not shown) coupled by connecting rods N^1 through roller bearings N^2 to crank pins O formed on circular webs O^1 located at the ends of the crankshafts O^2. The crankshafts O^2 are, as shown, mounted in roller bearings O^3 disposed eccentrically within bosses P rotatably carried in housings P^1 in the crank cases or frames M. The bosses P carry gear wheels P^2 which engage gear wheels P^3 on a transverse shaft Q carrying also a worm wheel Q^1 engaged by a worm Q^2 on a controlling shaft Q^3 whereby the shaft Q can be rotated to rotate the bosses P and thus move the crankshafts O^2 bodily towards or away from the cylinders N for the purpose of causing the pistons to uncover the supercharging ports N^0 in the cylinder wall at the end of their suction strokes or not to uncover such ports. As in the construction shown in Figures 1 and 2 the adjacent ends of the crankshafts O^2 are connected together and to a gear wheel R whereby power can be transmitted to a gear wheel for example as indicated at L^1 in Figures 1 and 2 and thence through a variable speed gear to a transmission shaft coupled to the track wheels.

The mechanism for rotating the bosses H or P may be coupled to mechanism for controlling the fuel injection apparatus so as to enable a larger quantity of fuel to be injected when the supercharge is admitted than when the engine is operating under normal conditions without supercharging. The supercharging charge may be delivered in various ways, for example from a blower driven by the crankshaft or from the crank case.

Further, if desired, instead of the variable speed transmission mechanism being carried by a transverse transmission shaft, it may be separately supported and may be connected to the transmission shaft by suitable transmission mechanism.

Alternatively an arrangement may be employed such as that diagrammatically shown in plan in Figure 4. In this construction the power unit comprises a framework or casing S in which are mounted bearings S^1 for the crankshaft S^2, of an engine of the kind shown for example in Figure 3, having two cranks S^3 each of which is acted upon by the connecting rods of pistons disposed in three radially arranged cylinders.

In the construction shown in Figure 4 the crankshaft S^2 supports two gear wheels T, T^1, the gear wheel T being rigidly connected to the shaft S^2 while the gear wheel T^1 is freely mounted on the shaft S^2 and is connected to the gear wheel T by a unidirectional clutch device or ratchet T^2 which permits the gear wheel T^1 to over-run the gear wheel T.

The gear wheels T and T^1 mesh respectively with gear wheels U and U^1 each of which is freely mounted on a layshaft U^2, the gear wheels U and U^1 being capable of being connected to this layshaft selectively by hydraulic clutches preferably of the known gear wheel pump type. The layshaft U^2 carries a further gear wheel U^3 which meshes with a gear wheel V on a jack shaft V^1 coupled to the track wheels, for example, of a locomotive. The layshaft U^2 may also carry a second gear wheel U^4 which meshes with an intermediate gear wheel, indicated at U^5, meshing with a gear wheel V^3 on the shaft V^1, means being provided for rendering operative either the gear element constituted by the gear wheels U^3, V or U^4, U^5, V^3 whereby rotation can be transmitted from the shaft U^2 to the shaft V^1 either in the forward or the reverse direction.

The operation of the power unit is as follows. The engine, of which the crankshaft S^2 is shown, operates in the same way as the engine shown in Figure 3 so that rotation is transmitted from the gear wheel T to the gear wheel U and from the gear wheel T^1 to the gear wheel U^1. By connecting the gear wheel U^1 to the shaft U^2 by its hydraulic clutch, power can be transmitted at a low gear ratio from the crankshaft S^2 to the layshaft U^2 and thence to the jack shaft V^1. If now

the hydraulic clutch for connecting the gear wheel U to the layshaft U^2 is progressively brought into operation, a greater and greater proportion of the power will be transmitted from the crankshaft S^2 to the layshaft U^2 through the gear wheels T and U until a point is reached at which the gear wheel T^1 tends to be driven through the gear wheels T, U and U^1 at a greater speed than the shaft S^2, whereupon the gear wheel T^1 will begin to over-run the shaft S^2, this over-running being permitted by the free-wheel device T^2. The clutch for connecting the gear wheel U to the shaft U^2 can now be further progressively engaged until the gear wheel U is virtually rigidly connected to the shaft U^2 when power will be transmitted at the high gear ratio from the shaft S^2 through the gear wheels T and U to the layshaft U^2 and thence to the jack shaft V^1.

Thus first the low gear ratio can be brought progressively into operation and then the high gear ratio can be progressively brought into operation without any break in the continuity of the transmission of power.

It will be seen that with power units according to the present invention as shown, for example, in Figures 1 and 2 or in Figure 3, the engine structure can be made only of sufficient strength to withstand the normal working pressures without supercharging and will operate with supercharging at increased output during overload conditions without increasing the stresses in the various parts of the engine.

It is to be understood that the constructions more particularly described above are given by way of example only and that the number of cylinders in each cylinder group, the direction in which the axes of these cylinders project, the form of mechanism for transmitting power from an intermediate point in the two-throw crankshaft to the track wheels of the locomotive, and other details of construction may be varied without departing from this invention.

Having now particularly described and ascertained the nature of my said invention and in what manner the same to be performed, I declare that what I claim is:—

1. In an internal combustion engine power unit, the combination with a two-throw crankshaft having means for transmitting power from a point in the length of the crankshaft between the two crank throws, of two groups of radially arranged cylinders disposed so that each crank throw is acted on by the pistons in the cylinders in one group, each group comprising a plurality of cylinders which lie adjacent and all on one side of a plane containing the crankshaft axis.

2. In an internal combustion engine power unit as claimed in Claim 1, the combination with the crankshaft, of means for moving this shaft bodily towards or away from the cylinders so as to vary the effective compression ratio, and supercharging ports in the cylinder walls so placed that when the crankshaft is moved towards the cylinders these supercharging ports are not uncovered by the pistons at the ends of their suction strokes, whereas when the crankshaft is moved away from the cylinders these supercharging ports will be uncovered at the end of each suction stroke to admit a supercharge.

3. An internal combustion engine power unit as claimed in Claim 2, in which the supercharge admitted is so determined in relation to the bodily movement of the crankshaft towards or away from the cylinders that the maximum compression pressure in the cylinders is substantially the same when supercharging with reduced effective compression ratio as when operating without supercharging at higher effective compression ratio.

4. An internal combustion engine power unit as claimed in Claim 1, Claim 2 or Claim 3, in which three cylinders are associated with each crank throw.

5. An internal combustion engine power unit as claimed in any one of the preceding claims, in which the mean direction of the axes of the cylinders of each group is substantially vertical.

6. In an internal combustion engine power unit as claimed in any one of the preceding claims for rail locomotives, the combination with a two-throw crankshaft disposed transversely with respect to the length of the locomotive, of means for transmitting power to the track wheels through a reduction variable speed mechanism from a point in the length of the crankshaft between the two crank throws.

7. In an internal combustion engine power unit for rail locomotives as claimed in Claim 1, Claim 2, Claim 3, Claim 4 or Claim 5, the combination with the two-throw crankshaft, of means for transmitting power from a point in the length of the crankshaft between the two crank throws to the driving element of a variable speed gear comprising gear wheels in constant mesh and constituting gearing capable of transmission at a plurality of fixed gear ratios which are independent of torque variations, a hydraulic clutch or brake mechanism which is operative to cause transmission at one fixed ratio, a

second hydraulic clutch or brake mechanism operative to cause transmission at a second fixed ratio, and a free-wheel device or like means whereby the first clutch or brake mechanism can prevent relative rotation between two parts so as to cause transmission at said first fixed ratio but permits such relative rotation as is necessary when operating at the second fixed ratio so that by progressively bringing into operation the second clutch or brake mechanism a change can be made from the first to the second fixed ratio without controlling the first clutch mechanism, such clutch mechanism remaining operative to maintain transmission of torque until the moment when the torque transmission has been taken over by the operation of the second clutch or brake mechanism.

8. In an internal combustion engine power unit for rail locomotives as claimed in Claim 6, the combination with the two-throw crankshaft, of one or more gear wheels mounted on the crankshaft between the crank throws and constituting or meshing with the driving member of a variable speed gear, the driven member of which is constituted by or connected to a transverse shaft supported in bearings in the locomotive frame and provided at its ends with cranks or other means whereby it can be coupled to the track wheels of the vehicle for the purpose of transmitting power thereto.

9. The complete internal combustion engine power unit constructed and arranged substantially as described with reference to Figures 1 and 2 or Figure 3 or Figure 4 of the accompanying drawings.

Dated this 23rd day of July, 1931.

KILBURN & STRODE,
Agents for the Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1932.

SHEET 1

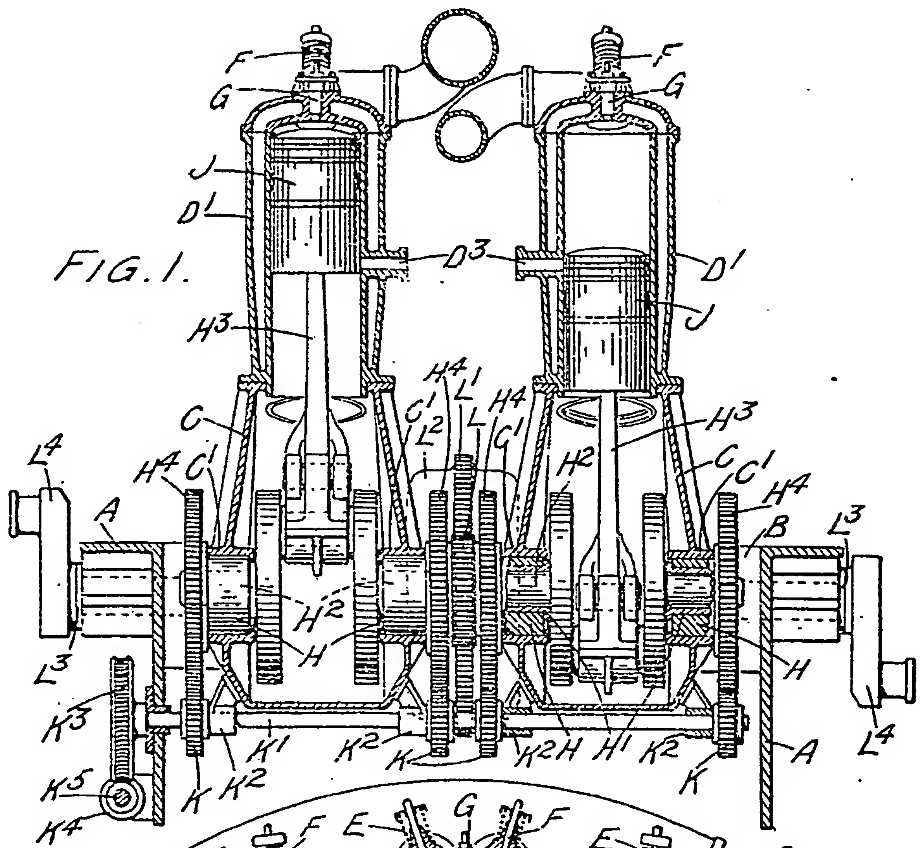

FIG. 1.

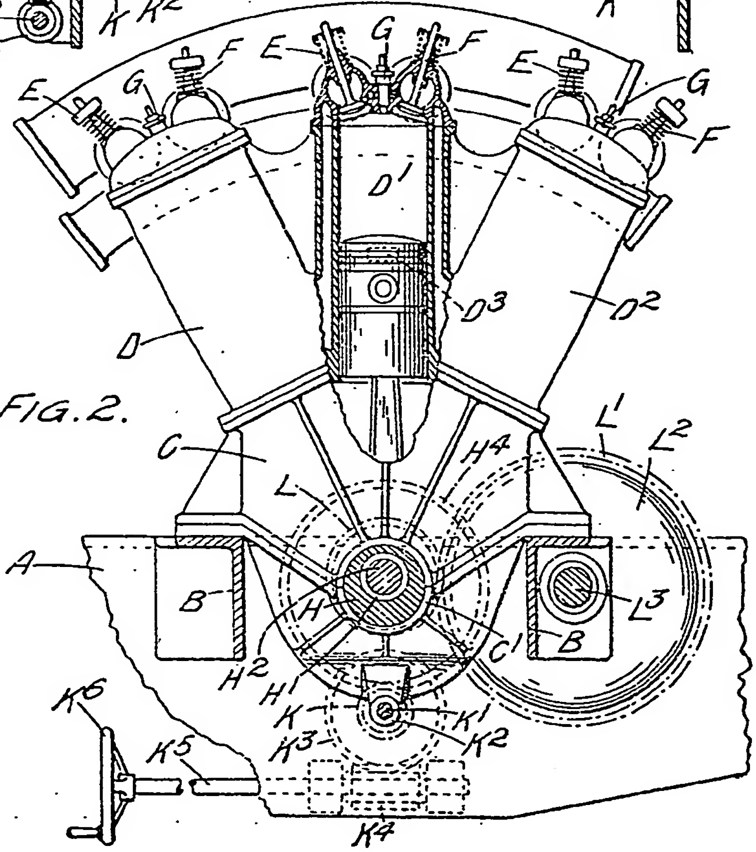

FIG. 2.

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FIG.3.

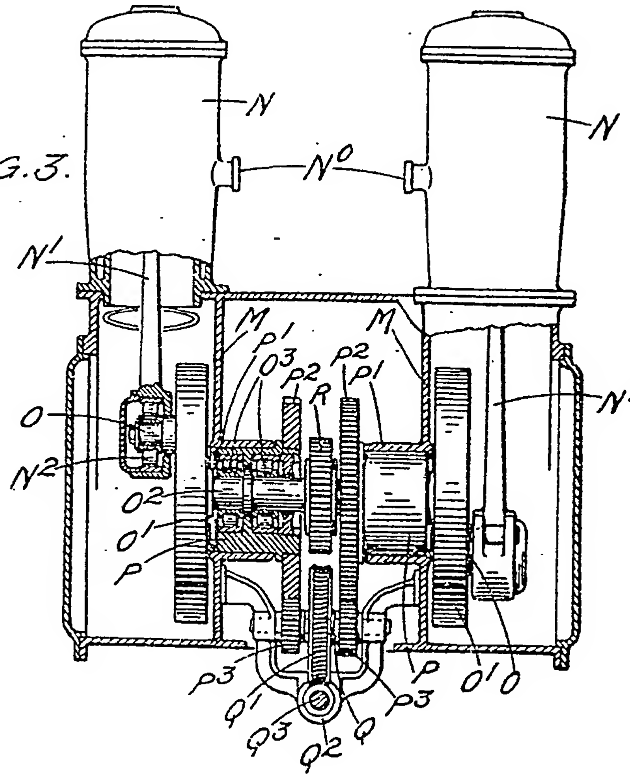
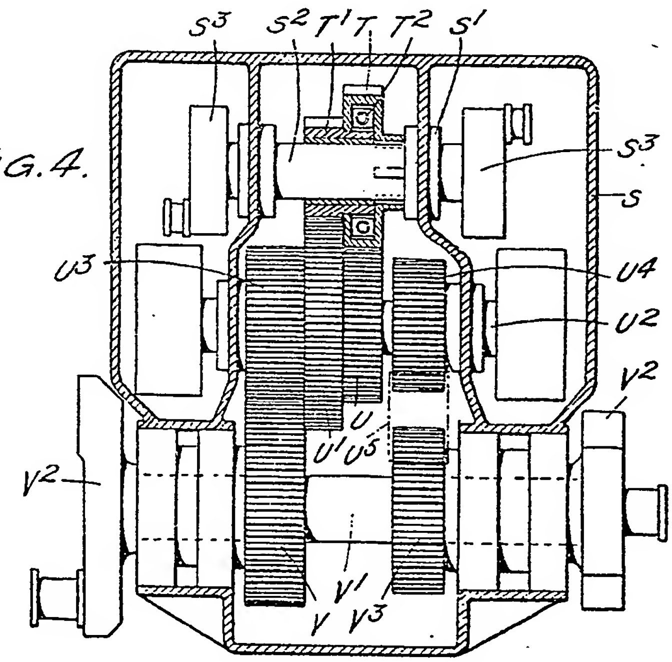


FIG.4.



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363,764 COMPLETE SPECIFICATION

SHEET 1

2 SHEETS

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FIG. 1.

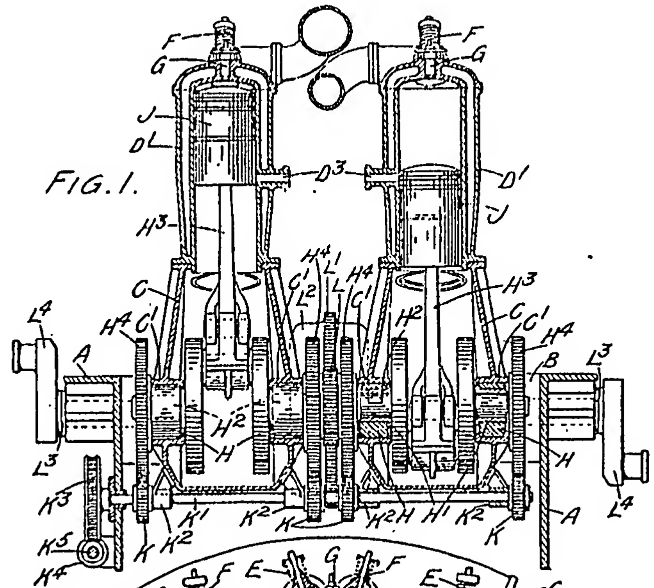


FIG. 2.

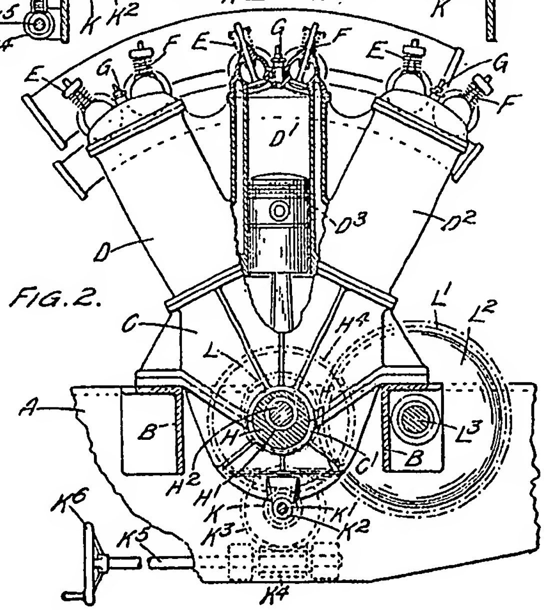


FIG. 3.

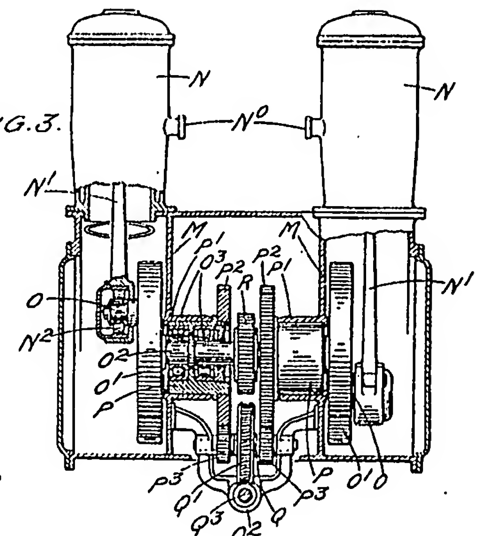
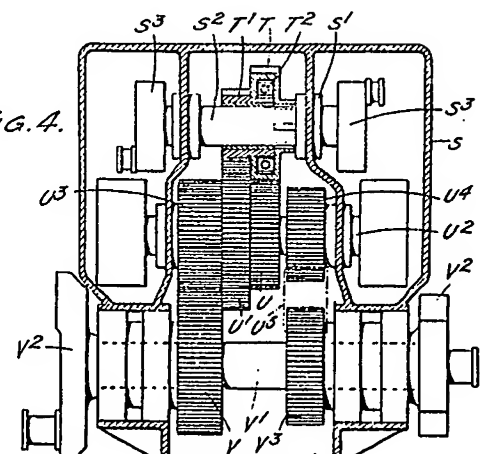


FIG. 4.



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